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ABSTRACT

This document is one of six which set forth the mathematics components of the Project SEARCH Articulated Curriculum developed by the Utica (New York) City School District. Each volume deals with a broad area of mathematics and lists objectives related to that area for all grades from K through 12. Each objective listed is described first in general terms and then in terms of specific skills which students should exhibit. This volume covers topics related to measurement. These include money, calendar, time, temperature, weight, linear measure, liquid measure, area and volume, error of measurement, and techniques of graphing and interpreting graphs. Both metric and English systems of measurement are used. (SD)

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Utica City School District



Articulated Curriculum

Project Search

1975

Draft Copy

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FORWARD

This Articulated Curriculum is being printed and bound in this manner to provide for on-going revision. This also serves as evidence of work completed during Phase III of Project SEARCH.

MATHEMATICS

K - 12

MEASUREMENT

ACKNOWLEDGEMENTS

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ARTICULATED CURRICULUM

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UTICA CITY SCHOOL DISTRICT

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MATHEMATICS

The Student Will Know:

Money

- the names of penny, nickel, dime and quarter.

Time

- the numerals on the clock relate to telling time.
 - the hour and minute hands on the clock.
- ### Temperature
- the position of the mercury indicates the temperature.

Linear

- the meaning of length as being long or short.
 - that the ruler, yardsticks and/or meter stick are used for measuring lengths.
 - the comparative sizes of large and small.
- ### Liquid
- the meaning of empty and full.
- ### Weight
- the meaning of the terms heavy and light.

Calendar

- the names of the days of the week in the proper order.

Money

- the monetary value of penny, dime, nickel, quarter.
- the equivalent coin combinations for nickels, dimes, and quarters.
- that the sign ¢ is used to show cents.

MEAS

The Student Will:

Grade K

- identify by name the real coins - penny, nickel, dime and quarter.

- find position of numerals on a clock.

- identify the numerals to which the hand points.

- use a movable thermometer to move the mercury indicator up when hot and down when cold.

- compare length of two objects using the terms long and short.

- use the ruler, yardstick, or meterstick to measure objects showing only how many ruler lengths it takes.

- compare size of various objects or sets using the terms large, small, larger, smaller, etc.

- identify containers which are full of liquid and those which are empty.

- determine which of two objects is heavy and is light.

- recite days of week in order.

Grade 1

- name each real coin, penny, dime, nickel, quarter and tell its value in cents.
- find equivalent coin combinations for nickel, dime, and quarter from among real or play coins.
- write money sums using the sign ¢.

Time

- the correct positions of the hours 1-12 on the face of the clock

- the time in hours on the clock face.

Temperature

- the association of high numbers with heat and low numbers with cold.

Linear

- the ruler divisions of inches and/or centimeters.

Liquid

- that volume is measured in terms of cups, pints, and quarts and/or liters in metrics and to know their relations to each other in terms of larger than or smaller than.

Weight

- that pounds and/or grams are units of weight as measured by a scale.

Calendar

- the names of months of the year in proper order.

Money

- the names and monetary value of half-dollars and dollar bills.

- the various equivalent coin combinations for half-dollar and dollar.

- the various combinations of coins up to 99¢

Grade 1

- fill in a clock face with numerals 1-12 in proper positions.

- tell and/or draw in designated time in whole hours on a clock face.

- record and compare various temperatures identifying the higher with warm conditions and the reverse.

- identify unit divisions on a ruler as inches or centimeters.

- state which liquid measure has more volume when presented with two different measures (ex. Which is larger a cup of water or a pint?)

- weigh and record weight of various objects on a scale in terms of pounds or grams.

- recite months of the year in order.

Grade 2

- identify a dollar and half-dollar and be able to state their value in cents.

- find equivalent coin combinations for half-dollar and dollar.

- use pennies, nickels, dimes, and quarters to find sums that do not exceed 99¢.

Time

- the time in $\frac{1}{2}$ hours on the clock face.

Linear

- that objects can be measured in terms of inches, and half inches or centimeters and millimeters, etc.

Liquid

- the equivalent values of cups, pints and quarts and/or liters.

Calendar

- the date to day calendar relationship.

Money

- the money signs \$ and (dollar sign and decimal point).

Time

- the relationship between hour, $\frac{1}{2}$ hour, $\frac{1}{4}$ hour, with 5 minute and 1 minute intervals
- the equivalents of hour, $\frac{1}{2}$ hour and minutes.
- sequence of time as related to earlier or later.

Grade 2

- fill in a clock face with the designated time on the $\frac{1}{2}$ hour.

- measure with inch or centimeter ruler given objects in inches, $\frac{1}{2}$ inches, or centimeters and millimeters.

- demonstrate the equivalent volume measures of cups, pints, liters.

- find a specific date on a calendar.

Grade 3

- write examples of money values or notations using appropriate sign.

- designate specific times given by drawing them in on the face of a clock.

- make many equivalent combinations as possible.

- state what time will be earlier or later than a state time (within the hour).

Temperature

- that a thermometer is divided into units called degrees.
- the number of inches in a foot, number of feet in a yard, number of inches in a yard
- the concept of length of lines may be measured to nearest inch.
- that units of measure are standard.
- that word problems can be written involving units of linear measure.

Liquid

- the equivalent measures for a gallon.
- that word problems can be written using liquid measures.

Weight

- the meaning of the terms, ounces, pounds and tons.
- the equivalence of ounces to pounds.

Calendar

- the number of days in a week, month, in a year and hours in a day.
- the equivalence of times.

- read and record temperatures using degree symbol.

- recite facts - write in answers to complete statements.

- will measure lines or objects to nearest inch correctly.

- compare equivalent units of measure on different scales (ex. an inch on a yardstick).

- compare an original problem involving these terms and demonstrate ability to solve.

- use concrete or abstract materials to formulate a list of equivalent combinations to a gallon.

- compose original problem involving these terms or solve one already written.

- identify items that can be measured in these units.

- recite ounce equivalent to pounds.

- construct a calendar and use a calendar to project future time.

- make as many equivalent combinations for periods of days and weeks totaling months.

Money

- the process for making change using the additive approach.
- the various bills up to \$50.00
- the equivalent combinations of bills and coins up to \$50.00
- that money values can be operated on ($+$, $-$, $\times$, $\div$) in both vertical and horizontal forms.

Time

- the meaning of and difference between A.M. and P.M.
- the meanings of dates written the short way. (ex. 5/29/75)

Temperature

- that the thermometer can be delineated in different degree amounts.

Linear

- the terms mile and rod, or kilometer and decimeter and their equivalencies.

Weight

- that any weight over 16 ounces can be renamed in ounces and pounds.
- the equivalencies of tons to pounds and grams and kilograms (etc.).

Grade 4

- make correct change using concrete and abstract materials.
- identify correctly bills up to \$50.00
- make various equivalent combinations of bills and coins up to \$50.00.
- solve equations and/or examples using money values.

- state behaviors appropriate to certain times of day, when given times written with A.M. and P.M. designations.

- write specific dates in the correct form.

- read and record temperatures on thermometers which are marked off on every degree every two degrees or every five degrees with accuracy.

- recite or list mile and rod or kilometer and decimeter equivalencies.

- be able to convert any number of ounces to pounds and ounces.
- be able to make correct conversions of pounds to tons and/or grams and kilograms.

Time

- the concept of time zones and the names and locations of those within the United States.
- the method for solving problems of time change.

Linear

- that speedometers measure speed in miles per hour and odometers measure distance traveled.

Temperature

- the number of Centigrade units in $5/9$ as great as the number of Fahrenheit units.

Linear

- the equivalent measures, square foot, square yards, acres, square rods, square miles. (sq. meters or kilometers).

- the perimeter is the sum of the measures of the sides of a polygon ($p = 2(1+w)$ $p = 4s$).

- the circumference is the perimeter of a circle. $c = \pi d = \pi 2r$.

- the area is the measure of the interior of a plane figure, $A = lw$, $A = \frac{1}{2}wb$, $A = \pi r^2$.

- the volume is the measure of the interior of a solid figure. $V = lwh$.

Grade 5

- identify the U.S. time zones on a map.
- solve correctly word problems involving time changes.

- read, solve and create problems involving speedometers and odometers.

Grade 6

- convert Centigrade to Fahrenheit temperatures and vice versa using formulas.

- solve problems using these conversions.

- find the perimeter of square, rectangle, triangle, using the formulas.

- find the circumference of a circle using the formulas.

- find the area of plane closed figures using the formulas.

- find the volume of rectangle solids.

- the English system:

Linear Measure - inch; foot; yard; rod; mile.
Liquid Measure - pint; quart; gallon; barrel
Weights - grain; ounce; pound; ton.

- the metric system:

Linear Measure - millimeter; centimeter; meter;
 kilometer
Liquid Measure - milliliter; centiliter; liter;
 kiloliter
Weights - milligram; centigram; gram; kilogram.

- the smaller the unit of measure, the greater is the precision.

- the greatest possible error of a measurement is equivalent to one-half the unit of measure being used.

- that relative error equals the greatest possible error divided by the unit of measure.

$$\text{Relative Error} = \frac{\text{Measure of Greatest Possible Error Measure}}{\text{Error Measure}}$$

- convert from a given unit of measure to an equivalent.

Example 1 - 2 miles = _____ yards
 Example 2 - 3 gallons = _____ quarts
 Example 3 - 2 tons = _____ ounces.

Grade 8

- convert from a given unit of measure to an equivalent.

Example 1 - 3 meters = _____ yards
 Example 2 - 560 milliliters = _____ centiliters
 Example 3 - 2 kilograms = _____ grams.

- recognize from a group of five measurements the most precise.

Example: determine the most precise unit of measure from the following:
 ounce; milligram;
 gram; grain; pound.

- calculate the greatest possible error of a given measurements.

Example: what is the greatest possible error of $3\frac{3}{4}$ in.? of $3\frac{3}{4}$ in.?
 Answers: $\frac{1}{4}$ in.; $\frac{1}{8}$ in.

- the students will demonstrate the computational skills derived from the concepts of unit of measure and greatest possible error.

Example: given measurement is 9 in. and the greatest possible error is .5 in., determine the relative error.

$$\frac{.5}{9} = .0555 \text{ or } 5.56\%$$

Grade 8

- that before adding measures, or subtracting measures, express all the measurements with the precision of the least precise measurement.
- that when finding the quotient or product of two numbers, use the least precise measurement and the other not, use the rule for addition of measures.

- express measures with the precision of the least precise measurement.
Example: express 74.923 and 28.49 with the precision of the least precise measurement.
Answer: 74.92; 28.49.

- apply the same rule for adding measures.
Example: find the circumference of a circle if the diameter is 27 cm. ($\pi = 3.14$)

$$\begin{array}{r} C = \pi D \\ C = 3.14 \times 27 \\ 3.14 - 3 \text{ significant digits} \\ \times 27 - 2 \text{ significant digits} \\ \hline 84.78 - \text{round this to 2 significant digits} \end{array}$$

65 - use this result.

Measurement

- the basic units of linear measurement in the English system and metric system.

- how to find unknown lengths using indirect

- the trigonometric functions of right triangles.

- to use the trigonometric tables (with no interpolation.)

Grade 9

- measure lines and objects with a ruler, yardstick, and meterstick.

- identify corresponding sides of similar triangles, and using a ratio of the corresponding sides will find an unknown length.

- given a right triangle, a student will be able to identify the sine, cosine or tangent ratio of an angle of that triangle.

- given an angle, the student will use this trig table to find the sine, cosine and tangent ratio of that angle as a decimal.

Grade 9

- given the sine, cosine or tangent ratio of an angle in decimal form, the student will find the measure of that angle.

Measurement

Grade 10

- the theorems involving the area of polygons.
- the theorems involving measurements of angles of polygons.
- the basic formula and definitions involved in coordinate geometry.

- calculate the area of a given polygon.

- be able to solve for the measures of the interior and exterior angles of a given polygon.

- be able to find the distance between two points.

- be able to find the midpoint of a line segment.

- be able to find the slope of a line.

- be able to write the equation of a line parallel or perpendicular to another line.

- the basic theorems involving angle measurement in circles.

- find the measure of angles, and arcs given various facts involving the circle.

- the theorems regarding inequality in one triangle or two triangles.

- present a proof showing one side greater than another side, or one angle greater than another angle in a given triangle or two triangles.

- the theorems involving angle sum.

- find the measure of a required angle given numerical expressions involving angles and sides of polygons.

Grade 10 - 12

- the techniques of model construction
- the metric system

- construct geometric models

- calculate in the metric system

- convert from English system to metric system

- convert from metric system to English system.

Measurement

- the definitions of relation, domain, range, function and inverse of a relation.
- the definitions of a linear function and quadratic function.
- the quadratic function.
- the definition of logarithmic function.
- the characteristic of the six trigonometric functions.
- the definitions of the accuracy and precision of a measurement.
- the common unit of angle measure which is a degree.
- the radian measures of different angles.
- the techniques used to calculate the mean, the median, and the mode using the data collected.
- the techniques used to calculate the mean and the standard deviation using the Monroe Calculator.

Grade 11

- apply these definitions to a given equation and/or a given inequality.
- determine if relation is a function.
- graph linear function.
- graph quadratic function.
- determine if two linear equations are parallel, perpendicular or intersecting.
- graph the quadratic function
- determine the axis of symmetry.
- determine the solution set.
- graph the logarithmic function.
- graph each trigonometric function.
- give in scientific notation, the weight of a sample of uranium precise to the nearest ten-thousandth of a gram
- compute the relative error as a per cent accurate to two significant digits.
- locate the point having a position angle with a stated measure.
- convert radian measure to degrees and degrees to radians.
- use the data collected to calculate the mean, the median and the mode.
- use the data collected to calculate the mean and the standard deviation using the Monroe Calculator.

Grade 11 - 12

Grade 11 - 12

- the techniques of finding 95% confidence interval for the true mean of a population.

Measurement

- the techniques of preparing graphs that represent a pictorial approach to a specific conic section.
- the application of knowledge of coordinate systems to graphing conic sections. (Special emphasis here is to eliminate the tedious plotting points method employed in earlier levels of instruction).

- the techniques needed to find the area between two curves.

- the techniques needed to find the volume of a solid of revolution by the disc, shell and washer methods.

- the techniques needed to find the area under a curve by the rectangular and trapezoidal approximation.

- the methods needed to find minimum and maximum areas and volumes by using derivatives.

- the formulae: area of a circle; surface area of a cylinder; surface area of a sphere; area of parallelogram, triangle, square, rectangle, trapezoid; surface area of a rectangular parallelepiped; volume of cylinder, cone, rectangular solid.

- find a 95% confidence interval for the true mean of a population.

Grade 12

- utilize output data from the computer that results from solving a problem relating to a specific conic section.

- interpret output data from a computer print-out and correlate it properly in units that results in an accurate graph of the conic section represented.

- investigate to a limited amount relations between metric and English systems in measurement systems used in graphics

- find the area between two curves.

- find the volume of a solid of revolution by the disc, shell, or washer methods.

- find the area under a curve by the rectangular and trapezoidal approximations.

- find minimum and maximum areas and volumes using derivatives.

- evaluate the formulae: area of a circle; surface area of a cylinder; surface area of a sphere; area of parallelogram, triangle, square, rectangle, trapezoid; surface area of a rectangular parallelepiped; volume of a cylinder, cone, rectangular solid.